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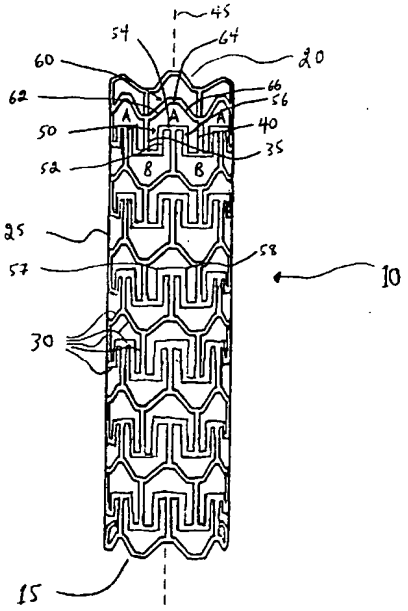
(54) STENT EXTENSIBLE ET METHODE D'INSTALLATION

(54) EXPANDABLE STENT AND METHOD FOR DELIVERY OF SAME



(57) Extenseur extensible comportant une extrémité proximale et une extrémité distale qui communiquent l'une avec l'autre. Une paroi tubulaire, placée entre les extrémités proximale et distale, comprend un axe longitudinal et une surface poreuse qui est définie par plusieurs éléments qui s'entrecoupent disposés de façon à créer une première unité répétitive ayant la forme d'un polygone. Le polygone comporte une paire de parois latérales, sensiblement parallèles à l'axe longitudinal, une première paroi concave possédant un premier apex et une deuxième paroi convexe possédant un deuxième apex. La première et la deuxième parois sont connectées aux parois latérales. Au moins un des premiers et des deuxièmes apex est sensiblement plat. L'extenseur passe d'une première position contractée à une deuxième position dilatée sous l'action d'une force s'exerçant radialement vers l'extérieur. Un extenseur bifurqué comportant la première unité répétitive est également divulgué.

(57) An expandable stent comprising a proximal end and a distal end in communication with one another. A tubular wall is disposed between the proximal end and the distal end. The tubular wall having a longitudinal axis and a porous surface defined by a plurality intersecting members arranged to define a first repeating pattern comprised of a polygon. The polygon has a pair of side walls substantially parallel to the longitudinal axis, a concave-shaped first wall having a first apex and a convex-shaped second wall having a second apex, the first wall and the second wall connecting the side walls. At least one of the first apex and the second apex is substantially flat. The stent is expandable from a first, contracted position to a second, expanded position upon the application of a radially outward force on the stent. A bifurcated stent including the first repeating pattern is also described.

ABSTRACT OF THE DISCLOSURE

An expandable stent comprising a proximal end and a distal end in communication with one another. A tubular wall is disposed between the proximal end and the distal end. The tubular wall having a longitudinal axis and a porous surface defined by a plurality intersecting members arranged to define a first repeating pattern comprised of a polygon. The polygon has a pair of side walls substantially parallel to the longitudinal axis, a concave-shaped first wall having a first apex and a convex-shaped second wall having a second apex, the first wall and the second wall connecting the side walls. At least one of the first apex and the second apex is substantially flat. The stent is expandable from a first, contracted position to a second, expanded position upon the application of a radially outward force on the stent. A bifurcated stent including the first repeating pattern is also described.

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EXPANDABLE STENT AND METHOD FOR DELIVERY OF SAME

The present invention relates to an expandable bifurcated stent and to a method for delivery of same.

Stents are generally known. Indeed, the term "stent" has been used interchangeably with terms such as "intraluminal vascular graft" and "expansible prosthesis". As used throughout this specification the term "stent" is intended to have a broad meaning and encompasses any expandable prosthetic device for implantation in a body passageway (e.g. a lumen or artery).

In the past six to eight years, the use of stents has attracted an increasing amount of attention due the potential of these devices to be used, in certain cases, as an alternative to surgery. Generally, a stent is used to obtain and maintain the patency of the body passageway while maintaining the integrity of the passageway. As used in this specification, the term "body passageway" is intended to have a broad meaning and encompasses any duct (e.g. natural or iatrogenic) within the human body and can include a member selected from the group comprising: blood vessels, respiratory ducts, gastrointestinal ducts and the like.

Initial stents were self-expanding, spring-like devices which were inserted in the body passageway in a contracted state. When released, the stent would automatically expand and increase to a final diameter dependent on the size of the stent and the elasticity of the body passageway. Such stents were known in the art as the Wallstent™.

The self-expanding stents were found by some investigators to be deficient since, when deployed, they could place undue, permanent stress on the walls of the body passageway. This lead to the development of various stents which were

controllably expandable at the target body passageway so that only sufficient force to maintain the patency of the body passageway was applied in expanding the stent.

Generally, in these later systems, a stent, in association with a balloon, is delivered to the target area of the body passageway by a catheter system. Once the stent has been properly located (for example, for intravascular implantation the target area of the vessel can be filled with a contrast medium to facilitate visualization during fluoroscopy), the balloon is expanded thereby expanding the stent so that the latter is urged in place against the body passageway. As indicated above, the amount of force applied is at least that necessary to maintain the patency of the body passageway. At this point, the balloon is deflated and withdrawn within the catheter, and subsequently removed. Ideally, the stent will remain in place and maintain the target area of the body passageway substantially free of blockage (or narrowing).

A stent which has gained some notoriety in the art is known as the Palmaz-Schatz™ Balloon Expandable Stent (hereinafter referred to as "the Palmaz-Schatz stent"). This stent is discussed in a number of patents including United States patents 4,733,665, 4,739,762, 5,102,417 and 5,316,023, the contents of each of which are hereby incorporated by reference.

Another stent which has gained some notoriety in the art is known as Gianturco-Roubin Flex-Stent™ (hereinafter referred to as "the Gianturco-Roubin stent"). This stent is discussed in a number of patents including United States patents 4,800,882, 4,907,336 and 5,041,126, the contents of each of which are hereby incorporated by reference.

Other types of stents are disclosed in the following patents:

United States patent 5,035,706 (Gianturco et al.),

United States patent 5,037,392 (Hillstead),
United States patent 5,147,385 (Beck et al.),
United States patent 5,282,824 (Gianturco),
Canadian patent 1,239,755 (Wallsten), and
Canadian patent 1,245,527 (Gianturco et al.),

the contents of each of which are hereby incorporated by reference.

While these prior art stents have achieved a varying degree of success, the art is constantly in need of new stents having improved flexibility and stability while being able to be readily implanted with little or no trauma to the target lumen.

In our Canadian patent application number 2,134,997, there is described an improved expandable stent. The stent comprises a tubular wall disposed between the proximal end and the distal end. The tubular wall has a longitudinal axis and a porous surface defined by a plurality intersecting members arranged to define a first repeating pattern. The first repeating pattern comprises a polygon having a pair of side walls substantially parallel to the longitudinal axis. A first concave-shaped wall and a second convex-shaped wall connect the side walls. The first wall and the second wall are equidistant along an axis which is parallel to the longitudinal axis. The stent is expandable from a first, contracted position to a second, expanded position upon the application of a radially outward force exerted on the stent.

As disclosed in the '997 application, the first repeating pattern can be implemented in, inter alia, a mono-tubular expandable stent and a bifurcated expandable stent.

While the stent disclosed in the '997 application is an advance in the art, in certain cases, a large force is required to achieve expansion in the target lumen.

Further, implantation of the stent disclosed in the '997 application can be difficult in certain situations where the unexpanded stent must travel through a significantly curved pathway to the target lumen.

Accordingly, it would be desirable to have an improved stent which overcomes these disadvantages. It would be further desirable if the improved stent could be readily adapted, inter alia, to mono-tubular expandable stents and bifurcated expandable stents. The latter type of stents would be useful in treating aneurysms, blockages and other ailments. It would also be desirable if such a stent was relatively easy to implant.

It is an object of the present invention to provide a novel expandable stent which obviates or mitigates at least one of the above-mentioned disadvantages of the prior art.

It is another object of the present invention to provide a novel method for implanting an expandable bifurcated stent.

Accordingly, in one of its aspects, the present invention provides an expandable stent comprising a proximal end and a distal end in communication with one another, a tubular wall disposed between the proximal end and the distal end, the tubular wall having a longitudinal axis and a porous surface defined by a plurality intersecting members arranged to define a first repeating pattern comprised of a polygon having a pair of side walls substantially parallel to the longitudinal axis, a concave-shaped first wall having a first apex and a convex-shaped second wall having a second apex, the first wall and the second wall connecting the side walls, at least one of the first apex and the second apex being substantially flat, the stent being expandable from a first, contracted position to a second, expanded position upon the application of a radially outward force on the stent.

In another of its aspects, the present invention provides an expandable bifurcated stent comprising a proximal end and a distal end in communication with one another, the proximal end comprising a primary passageway and the distal end comprising a pair of secondary passageways, the stent being expandable from a first, contracted position to a second, expanded position upon the application of a radially outward force exerted on the stent, each of the primary and secondary passageways comprising tubular wall having a longitudinal axis and a porous surface defined by a plurality intersecting members arranged to define a first repeating pattern comprised of a polygon having a pair of side walls substantially parallel to the longitudinal axis, a concave-shaped first wall having a first apex and a convex-shaped second wall having a second apex, the first wall and the second wall connecting the side walls, at least one of the first apex and the second apex being substantially flat, the stent being expandable from a first, contracted position to a second, expanded position upon the application of a radially outward force on the stent.

Applicant that the use of a specific repeating pattern in a porous stent is particularly advantageous. Generally, the repeating pattern is a polygon having a pair of side walls substantially parallel to the longitudinal axis of the tubular wall of the stent, and a concave-shaped first wall and a convex-shaped second wall connecting the side walls. As used throughout this specification, the terms "concave-shaped" and "convex-shaped" are intended to have a broad meaning and a shape having apex. Thus, the first wall has a first apex and the second wall has a second apex. Thus, the first apex (i.e. of the concave-shaped first wall) is directed into the polygon whereas the second apex (i.e. of the convex-shaped second wall) is directed away from the polygon.

It is has been discovered that an improved stent results when the repeating pattern is designed such that at least one of the first apex and second apex is substantially flat. The advantages associated with the use of such a repeating pattern include the following:

1. The force required to expand the stent is substantially reduced;
2. The stent is subjected to less traumatic stress during expansion;
3. Plastic deformation of the stent during expansion is facilitated; and
4. Construction of the stent is facilitated.

The provision of at least one of the first apex and the second apex being substantially flat results in the apex of the concave-shaped first wall and/or the convex-shaped second wall having a pair of shoulders. Preferably, these shoulders are rounded. The provision of such round shoulders results in the following additional advantages:

5. Mitigation of potential trauma to the target body passageway from: (i) endoluminal contents within the passageway, and (ii) the contours of the passageway;
6. The resulting expanded stent is more stream-line and flow-directed which mitigates potential trauma to the target body passageway;
7. Further reduction in the force required to expand the stent;

8. An improved stent expansion ratio is achieved (i.e. ratio of expanded stent diameter at maximum expansion to unexpanded stent diameter); and

9. Upon expansion of the stent, the concave-shaped first wall and the convex-shaped second wall are in a substantially orthogonal relationship to the longitudinal axis thereby improved the rigidity of the stent (this is very importing to mitigate the occurrence of stent collapse).

Another preferred feature of the stent of the present invention is the provision of a strut connecting the first apex and the second apex. This feature mitigates lifting of the shoulders referred to above as the stent is flexed, for example, when passing the stent through a curved body passageway. The result of this is that potential trauma to the body passageway is mitigated since scraping of the body passageway by the shoulders is mitigated.

In a preferred embodiment, the strut is curved with respect to the longitudinal axis (this is described and illustrated hereinbelow). Preferably, the strut has length of up to about 35%, more preferably up to about 15%, even more preferably in the range of from about 2% to about 8%, most preferably in the range of from about 3% to about 7%, greater than the distance between the first apex and the second apex. This feature improves the lateral flexibility of the strut thereby facilitating implantation thereof.

Yet another preferred feature of the stent of the present invention is the provision of one or both of the side walls of the polygon of the repeating pattern being curved. Preferably, both side walls are curved. Ideally, the curved side wall has length of up to about 35%, more preferably up to about 15%, even more

preferably in the range of from about 2% to about 8%, most preferably in the range of from about 3% to about 7%, greater than the distance between the termini of the concave-shaped first wall and the concave-shaped second wall. This feature improves the lateral flexibility of the strut thereby facilitating implantation thereof.

Preferably both the strut and the side walls are curved. More preferably each of the curved members are of substantially the same length.

An aspect of the present invention relates to the provision of an expandable bifurcated stent. As used throughout this specification, the term "bifurcated stent" is intended to have a broad meaning and encompasses any stent having a primary passageway to which is connected at least two secondary passageways. Thus, trifurcated stents are encompassed herein. Further, one of the secondary passageways can be a continuation of the primary passageway with the result that the other secondary passageway is essentially a side branch to the primary passageway.

The stent of the present invention (bifurcated or mono-tubular) can further comprise coating material therein. The coating material can be one or more of a biologically inert material (i.e. to reduce the thrombogenicity of the stent), a medicinal composition which leaches in the wall of the body passageway after implantation (e.g. to provide anticoagulant action and the like).

Embodiments of the present invention will be described with reference to the accompanying drawings wherein like numerals designate like parts and in which:

Figure 1 illustrates an exploded perspective view of a mono-tubular stent prior to expansion; and

Figures 2-6 illustrate a two dimensional representation of various embodiments (not to relative scale) of a repeating pattern useful in the stent of the present invention.

With reference to Figure 1, there is illustrated a stent 10. Stent 10 comprises a proximal end 15 and a distal end 20. Stent further comprises a tubular wall 25 disposed between proximal end 15 and distal end 20. As illustrated, tubular wall 25 is porous. The porosity of tubular wall 25 is defined by a plurality of intersecting members 30. Intersecting members 30 define a first repeating pattern designated A in Figure 1.

As illustrated, repeating pattern A is a polygon comprising a pair of side walls 35,40. Side walls 35,40 are substantially parallel to a longitudinal axis 45 of stent 10. Side walls 35,40 are connected by a concave-shaped wall 50 and a convex-shaped wall 60.

As illustrated, concave-shaped wall 50 is made up of a trio of segments 52,54,56. In the illustrated embodiment, segment 54 is the apex of concave-shaped wall 54. As is evident, segment 54 is a flat apex and results in the provision of a pair of substantially square shoulders 57,58 Convex-shaped wall 60 is made up of a trio of segments 62,64,66. In the illustrated embodiment, segment 64 is the apex of convex-shaped wall 60.

It will be appreciated by those of skill in the art that the provision of first repeating pattern A, as illustrated, necessarily defines and provides for a second repeating pattern B. It will also be appreciated by those of skill in the art that second repeating pattern B is a mirror image of first repeating pattern A taken along an axis (not shown) substantially normal to longitude axis 45.

It will be further appreciated by those of skill in the art that the shape of concave-shaped wall 50 and/or convex-shaped wall 60 can be modified without departing from the function and performance of the stent provided that at least one of concave-shaped wall 50 and convex-shaped wall 60 retain a substantially flat apex. For example, the trio of segments can be replaced by a suitably curved or

arcuate wall. Alternatively, more than three segments can be used to define concave-shaped wall 50 and/or convex-shaped wall 60. Other modifications will be apparent to those of skill in the art.

It will be further appreciated by those of skill in the art that various walls of first repeating pattern A and second repeating pattern B may be omitted (and even desired) at selected points along the body of the stent without departing from the spirit and scope of the invention. For example, it is possible to omit one or both of side walls 35 and 40 at selected points along the body of the stent with a view to improving the longitudinal flexibility of the stent. Further, it is possible to omit one or more of segments 62,64,66 at selected points along the body of the stent with a view to improving the lateral flexibility of the stent.

Still further, the stent depicted in Figure 1 can be modified to omit, on a selected basis, first repeating pattern A and/or second repeating B with a view to improve flexibility of the stent and to allow access to other structures (e.g. side branches/arteries) outside the bounds of the stent.

With reference to Figures 2-6, there are illustrated a number of preferred embodiments of repeating pattern A. For the sake of clarity, numerals in Figures 2-6 have the same final two digits as the corresponding numerals in Figure 1. Thus, for example, the concave-shaped wall is depicted has element 50 in Figure 1, element 150 in Figure 2, element 250 in Figure 3, etc.

Thus, as illustrated in Figure 2, repeating pattern A is comprised of a concave-shaped wall 150 and a convex-shaped wall 160, the former having a flat apex. Further, as illustrated, concave-shaped wall 150 and convex-shaped wall 160 are not equidistant along an axis orthogonal to the longitudinal axis of the stent (not shown). Thus, in this embodiment, the flat apex in concave-shaped wall 150 has

been modified such that it comprises a pair of substantially rounded shoulders 157,158.

With reference to Figure 3, repeating pattern A is similar to the one illustrated in Figure 1. In Figure 3, the flat apex of concave-shaped wall 250 has been modified to provide a pair of rounded shoulders 257,258. Further, a strut 270 has been added to connect segment 254 of concave-shaped wall 250 and segment 264 of convex-shaped wall 260. As illustrated, strut 270 is thinner in dimension that any of the segments making up concave-shaped wall 250 and convex-shaped wall 260. Thus, strut 270 may be considered as a relatively thin retention wire which reconciles the need for retaining flexibility in the strut with mitigating lifting of rounded shoulders 257,258.

With reference to Figure 4, repeating pattern A is similar to the one illustrated in Figure 1. In Figure 4, the flat apex of concave-shaped wall 350 has been modified to provide a pair of rounded shoulders 357,358. Further, a curved strut 370 has been added to connect segment 354 of concave-shaped wall 350 and segment 364 of convex-shaped wall 360.

With reference to Figure 5, repeating pattern A is similar to the one illustrated in Figure 1. In Figure 5, the flat apex of concave-shaped wall 450 has been modified to provide a pair of rounded shoulders 457,458. Further, a curved strut 470 has been added to connect segment 454 of concave-shaped wall 450 and segment 464 of convex-shaped wall 460. Further, side walls 435,440 are also curved.

With reference to Figure 6, repeating pattern A is similar to the one illustrated in Figure 1. In Figure 6, concave-shaped wall 550 has been modified to have a flat apex 554 having a pair of rounded shoulders 557,558 and convex-shaped wall 560 has been modified also to have a flat apex 564 having a pair of rounded

shoulders 567,568. Further, a curved strut 570 has been added to connect segment 554 of concave-shaped wall 550 and segment 564 of convex-shaped wall 560. Further, side walls 535,540 are also curved.

The advantages of the various alternate embodiments illustrated in Figures 2-6 is discussed herein above. Those of skill in the art will recognize that it is possible to combine various of the alternate embodiments illustrated in Figures 2-6 to derive further design which are still within the spirit and scope of the present application.

The manner by which the present stent is manufactured is not particularly restricted. Preferably, the stent is produced by laser cutting/welding techniques applied to tubular starting material. Thus, the starting material could be a thin tube of a metal or alloy (not limiting examples include stainless steel, titanium, tantalum, nitinol, Elgiloy, NP35N and mixtures thereof) which would then have sections thereof cut out to leave repeating pattern A discussed above. Thus, the preferred design of the present stent is one of a tubular wall which is distinct from prior art wire mesh designs wherein wire is conformed to the desired shape and welded in place. The preferred tubular wall design of the present stent facilitates production and improves quality control by avoiding the use of welds and, instead, utilizing specific cutting techniques.

Stent 10 can be implanted using a conventional system wherein a guidewire, catheter and balloon can be used to position and expand the stent. Implantation of mono-tubular stents such as stent 10 is conventional and within the purview of a person skilled in the art. See, for example, any one of United States patents 4,733,665, 4,739,762, 5,035,706, 5,037,392, 5,102,417, 5,147,385, 5,282,824, 5,316,023 and any of the references cited therein or any of the references cited hereinabove. When the present stent is constructed as a bifurcated stent, to may be

implanted using the procedure outlined in the '997 patent application incorporated herein by reference.

It will be apparent to those of skill in the art that implantation of stent 10 can be accomplished by various other means. For example, it is contemplated that the stent can be made of a suitable material which will expand when a certain temperature is reached. In this embodiment, the material may be a metal alloy (e.g. nitinol) capable of self-expansion at a temperature of at least about 30°C, preferably in the range of from about 30° to about 40°C. In this embodiment, the stent could be implanted using a conventional catheter and the radially outward force exerted on the stent would be generated within the stent itself. Further, stent 10 can be designed to expand upon the application of mechanical forces other than those applied by a balloon/catheter. For example, it is possible to implant stent 10 using a catheter equipped with a resisting sleeve or retaining membrane which may then be removed with the catheter once the stent is in position thereby allowing the stent to expand. Thus, in this example, the stent would be resiliently compressed and would self-expanded once the compressive force (i.e. provided by the sleeve or membrane) is removed.

As will be appreciated by those of skill in the art, repeating pattern A has been described hereinabove and illustrated in Figure 1 in respect of a monotubular stent. Repeating pattern A and all of the features relating thereto illustrated in and described with reference to Figures 1-6 is equally applicable to a bifurcated stent such as the one described and illustrated in the '997 application discussed hereinabove, the contents of which are hereby incorporated by reference.

While this invention has been described with reference to illustrative embodiments, this description is not intended to be construed in a limiting sense. Various modifications of the illustrative embodiments, as well as other embodiments

of the invention , will be apparent to persons skilled in the art upon reference to this description. It is therefore contemplated that the appended claims will cover any such modifications or embodiments.

What is claimed is:

1. An expandable stent comprising a proximal end and a distal end in communication with one another, a tubular wall disposed between the proximal end and the distal end, the tubular wall having a longitudinal axis and a porous surface defined by a plurality intersecting members arranged to define a first repeating pattern comprised of a polygon having a pair of side walls substantially parallel to the longitudinal axis, a concave-shaped first wall having a first apex and a convex-shaped second wall having a second apex, the first wall and the second wall connecting the side walls, at least one of the first apex and the second apex being substantially flat, the stent being expandable from a first, contracted position to a second, expanded position upon the application of a radially outward force on the stent.

2. The stent defined in claim 1, wherein both the first apex and the second apex are substantially flat.

3. The stent defined in claim 2, wherein the first apex and the second apex are of different length.

4. The stent defined in claim 2, wherein the first apex and the second apex are of the same length.

5. The stent defined in claim 4, wherein the first wall and the second wall are substantially equidistant from one another along an axis parallel to the longitudinal axis.

6. The stent defined in claim 1, wherein one of the first apex and the second apex is substantially arcuate.

7. The stent defined in claim 1, further comprising a strut connecting the first apex to the second apex.

8. The stent defined in claim 7, wherein the strut is curved with respect to the longitudinal axis.

9. The stent defined in claim 8, wherein the strut has length of up to about 35% greater than the distance between the first apex and the second apex.

10. The stent defined in claim 8, wherein the strut has a length up to about 15% greater than the distance between the first apex and the second apex.

11. The stent defined in claim 8, wherein the strut has a length in the range of from about 2% to about 8% greater than the distance between the first apex and the second apex.

12. The stent defined in claim 8, wherein the strut has a length in the range of from about 3% to about 7% greater than the distance between the first apex and the second apex.

13. The stent defined in claim 1, wherein the side walls are substantially equidistant from one another along an axis orthogonal to the longitudinal axis of stent.

14. The stent defined in claim 1, wherein one of the side walls is curved with respect to the longitudinal axis.

15. The stent defined in claim 14, wherein the one of the side walls which is curved has a length up to about 35% greater than the distance between the respective termini of the first wall and the second wall.

16. The stent defined in claim 14, wherein the one of the side walls which is curved has a length up to about 15% greater than the distance between the respective termini of the first wall and the second wall.

17. The stent defined in claim 14, wherein the one of the side walls which is curved has a length in the range of from about 2% to about 8% greater than the distance between the respective termini of the first wall and the second wall.

18. The stent defined in claim 14, wherein the one of the side walls which is curved has a length in the range of from about 3% to about 7% greater than the distance between the respective termini of the first wall and the second wall.

19. The stent defined in claim 1, wherein both of the side walls are curved with respect to the longitudinal axis.

20. The stent defined in claim 19, wherein the side walls have a length up to about 35% greater than the distance between the respective termini of the first wall and the second wall.

21. The stent defined in claim 19, wherein the side walls have a length up to about 15% greater than the distance between the respective termini of the first wall and the second wall.

22. The stent defined in claim 19, wherein the side walls have a length in the range of from about 2% to about 8% greater than the distance between the respective termini of the first wall and the second wall.

23. The stent defined in claim 19, wherein the side walls have a length in the range of from about 3% to about 7% greater than the distance between the respective termini of the first wall and the second wall.

24. The stent defined in claim 1, wherein the stent is constructed of stainless steel.

25. The stent defined in claim 1, wherein the stent is constructed of a self-expanding material.

26. The stent defined in claim 25, wherein the self-expanding material is nitinol.

27. The stent defined in claim 25, wherein the self-expanding material expands at a temperature of greater than about 30°C.

28. The stent defined in claim 25, wherein the self-expanding material expands at a temperature of in the range of from about 30° to about 40°C.

29. An expandable bifurcated stent comprising a proximal end and a distal end in communication with one another, the proximal end comprising a primary passageway and the distal end comprising a pair of secondary passageways, the stent being expandable from a first, contracted position to a second, expanded position upon the application of a radially outward force exerted on the stent, each of the primary and secondary passageways comprising tubular wall having a longitudinal axis and a porous surface defined by a plurality intersecting members arranged to define a first repeating pattern comprised of a polygon having a pair of side walls substantially parallel to the longitudinal axis, a concave-shaped first wall having a first apex and a convex-shaped second wall having a second apex, the first wall and the second wall connecting the side walls, at least one of the first apex and the second apex being substantially flat, the stent being expandable from a first, contracted position to a second, expanded position upon the application of a radially outward force on the stent.

30. The bifurcated stent defined in claim 29, wherein both the first apex and the second apex are substantially flat.

31. The bifurcated stent defined in claim 30, wherein the first apex and the second apex are of different length.

32. The bifurcated stent defined in claim 30, wherein the first apex and the second apex are of the same length.

33. The bifurcated stent defined in claim 32, wherein the first wall and the second wall are substantially equidistant from one another along an axis parallel to the longitudinal axis.

34. The bifurcated stent defined in claim 29, wherein one of the first apex and the second apex is substantially arcuate.

35. The bifurcated stent defined in claim 29, further comprising a strut connecting the first apex to the second apex.

36. The bifurcated stent defined in claim 35, wherein the strut is curved with respect to the longitudinal axis.

37. The bifurcated stent defined in claim 36, wherein the strut has length of up to about 35% greater than the distance between the first apex and the second apex.

38. The bifurcated stent defined in claim 36, wherein the strut has a length up to about 15% greater than the distance between the first apex and the second apex.

39. The bifurcated stent defined in claim 36, wherein the strut has a length in the range of from about 2% to about 8% greater than the distance between the first apex and the second apex.

40. The bifurcated stent defined in claim 36, wherein the strut has a length in the range of from about 3% to about 7% greater than the distance between the first apex and the second apex.

41. The bifurcated stent defined in claim 29, wherein the side walls are substantially equidistant from one another along an axis orthogonal to the longitudinal axis of stent.

42. The bifurcated stent defined in claim 29, wherein one of the side walls is curved with respect to the longitudinal axis.

43. The bifurcated stent defined in claim 42, wherein the one of the side walls which is curved has a length up to about 35% greater than the distance between the respective termini of the first wall and the second wall.

44. The bifurcated stent defined in claim 42, wherein the one of the side walls which is curved has a length up to about 15% greater than the distance between the respective termini of the first wall and the second wall.

45. The bifurcated stent defined in claim 42, wherein the one of the side walls which is curved has a length in the range of from about 2% to about 8% greater than the distance between the respective termini of the first wall and the second wall.

46. The bifurcated stent defined in claim 42, wherein the one of the side walls which is curved has a length in the range of from about 3% to about 7% greater than the distance between the respective termini of the first wall and the second wall.

47. The bifurcated stent defined in claim 29, wherein both of the side walls are curved with respect to the longitudinal axis.

48. The bifurcated stent defined in claim 47, wherein the side walls have a length up to about 35% greater than the distance between the respective termini of the first wall and the second wall.

49. The bifurcated stent defined in claim 47, wherein the side walls have a length up to about 15% greater than the distance between the respective termini of the first wall and the second wall.

50. The bifurcated stent defined in claim 47, wherein the side walls have a length in the range of from about 2% to about 8% greater than the distance between the respective termini of the first wall and the second wall.

51. The bifurcated stent defined in claim 47, wherein the side walls have a length in the range of from about 3% to about 7% greater than the distance between the respective termini of the first wall and the second wall.

52. The bifurcated stent defined in claim 29, wherein the stent is constructed of stainless steel.

53. The bifurcated stent defined in claim 29, wherein the stent is constructed of a self-expanding material.

54. The bifurcated stent defined in claim 53, wherein the self-expanding material is nitinol.

55. The bifurcated stent defined in claim 53, wherein the self-expanding material expands at a temperature of greater than about 30°C.

56. The bifurcated stent defined in claim 53, wherein the self-expanding material expands at a temperature of in the range of from about 30° to about 40°C.

57. The bifurcated stent defined in claim 29, wherein the primary passageway is connected to the each of the secondary passageways at an intersection point.

58. The bifurcated stent defined in claim 57, wherein the intersection point is reinforced with respect to the remainder of the stent.

59. The bifurcated stent defined in claim 57, wherein the intersection point is porous.

60. The bifurcated stent defined in claim 59, wherein the porosity of the intersection point is defined by a plurality intersecting members.

61. The bifurcated stent defined in 60, wherein the intersecting members define a second repeating pattern.

62. The bifurcated stent defined in claim 61, wherein the second repeating pattern is a polygon having a pair of side walls substantially parallel to the

longitudinal axis of the primary passageway, a concave-shaped first wall and a convex-shaped second wall connecting the side walls, the side walls being substantially equidistant along an axis which is parallel to the longitudinal axis of the primary passageway, and a reinforcing bar disposed between and substantially parallel to the pair of side walls.

63. The bifurcated stent defined in claim 62, wherein the reinforcing bar is disposed substantially equidistant from each of the side walls.

64. The bifurcated stent defined in claim 29, wherein the primary passageway has a substantially circular cross-section.

65. The bifurcated stent defined in claim 29, wherein each of the secondary passageways has a substantially circular cross-section.

66. The bifurcated stent defined in claim 29, wherein the cross-sectional area of the primary passageway is substantially the same as the sum of the cross-sectional areas of each secondary passageway.

67. The bifurcated stent defined in claim 29, wherein the distal end is flexible with respect to the remainder of the stent.

68. The bifurcated stent defined in claim 29, wherein the proximal end is flexible with respect to the remainder of the stent.

69. The bifurcated stent defined in claim 29, wherein the length of each of the primary passageway and the second passageways is substantially the same.

70. The bifurcated stent defined in claim 29, wherein the length of each of the primary passageway and the second passageways is different.

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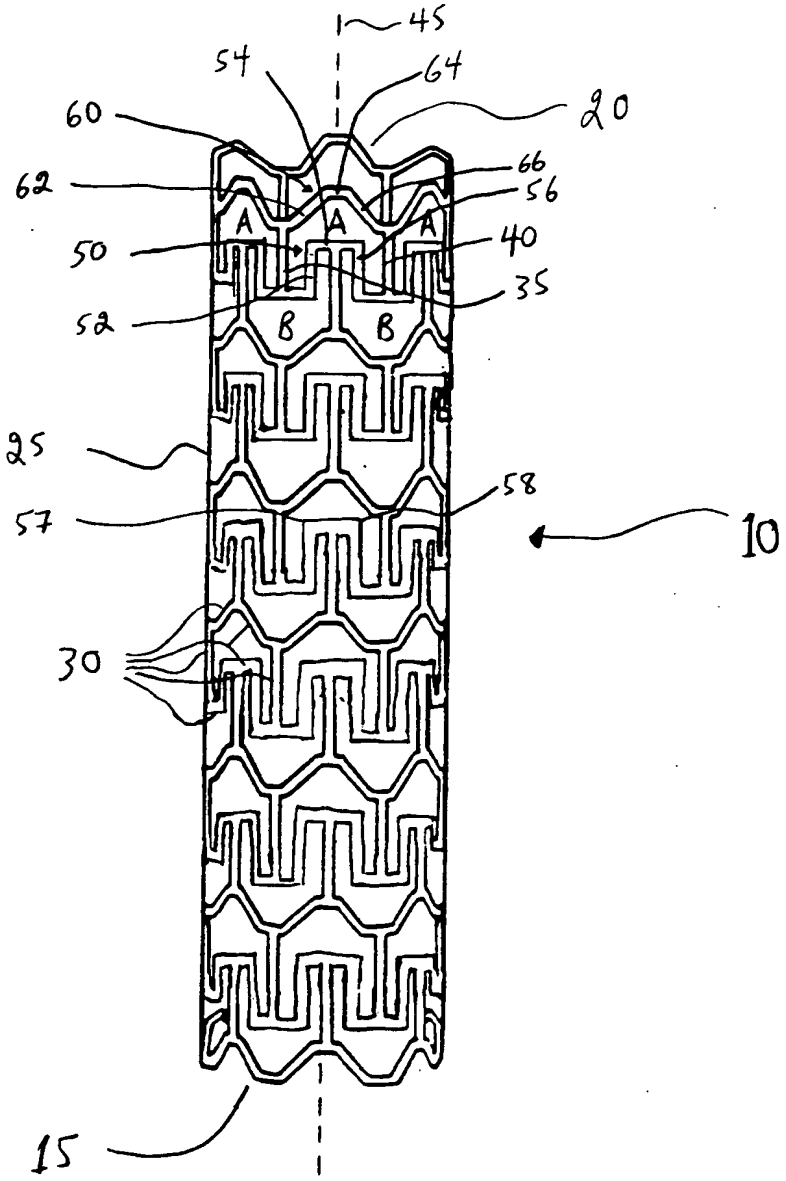

FIGURE 1

McCARTHY TÉTRAULT
AGENTS FOR THE APPLICANT

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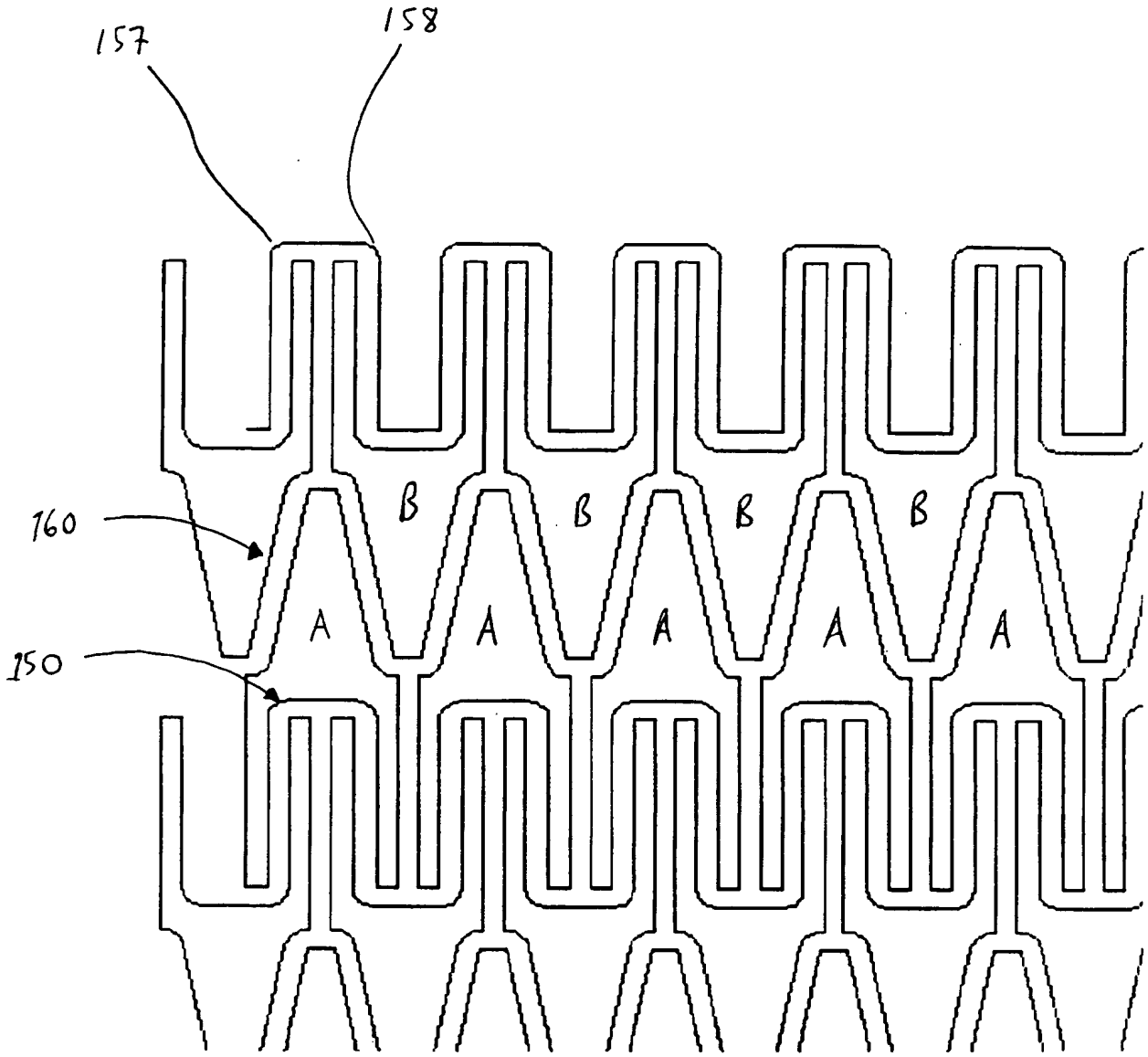

FIGURE 2

McCARTHY TÉTRAULT
AGENTS FOR THE APPLICANT

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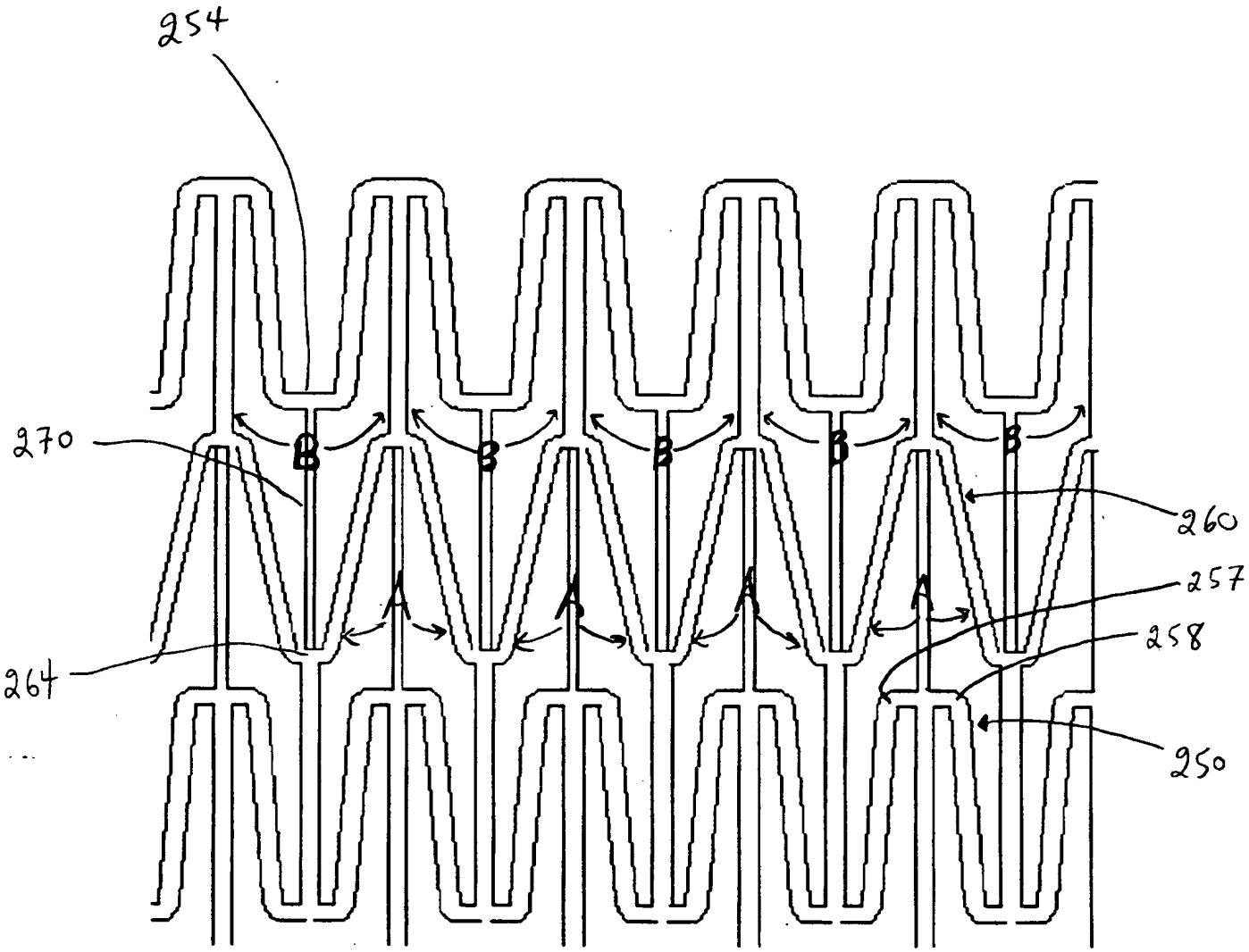

FIGURE 3

McCARTHY TÉTRAULT
AGENTS FOR THE APPLICANT

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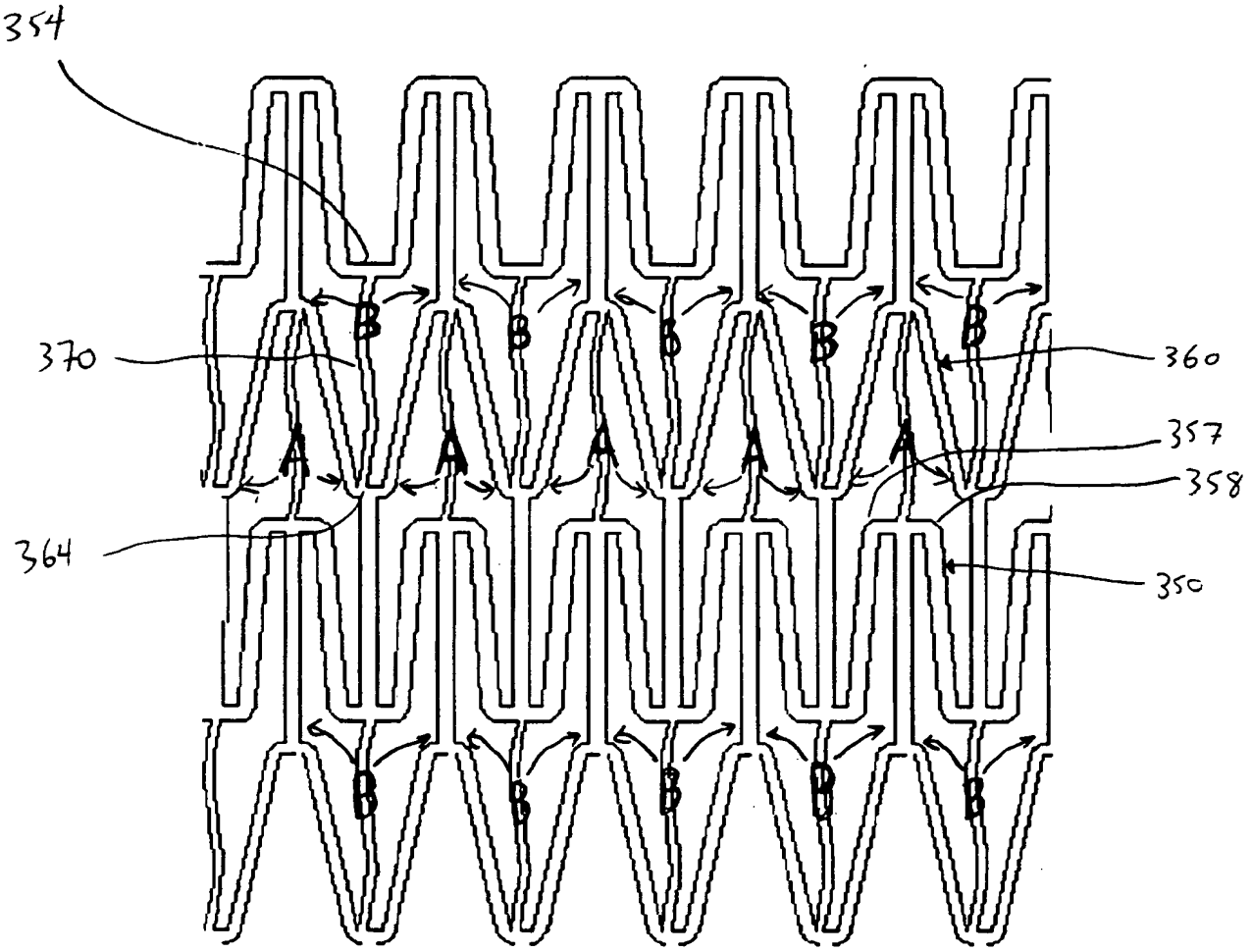

FIGURE 4

McCARTHY TÉTRAULT
AGENTS FOR THE APPLICANT

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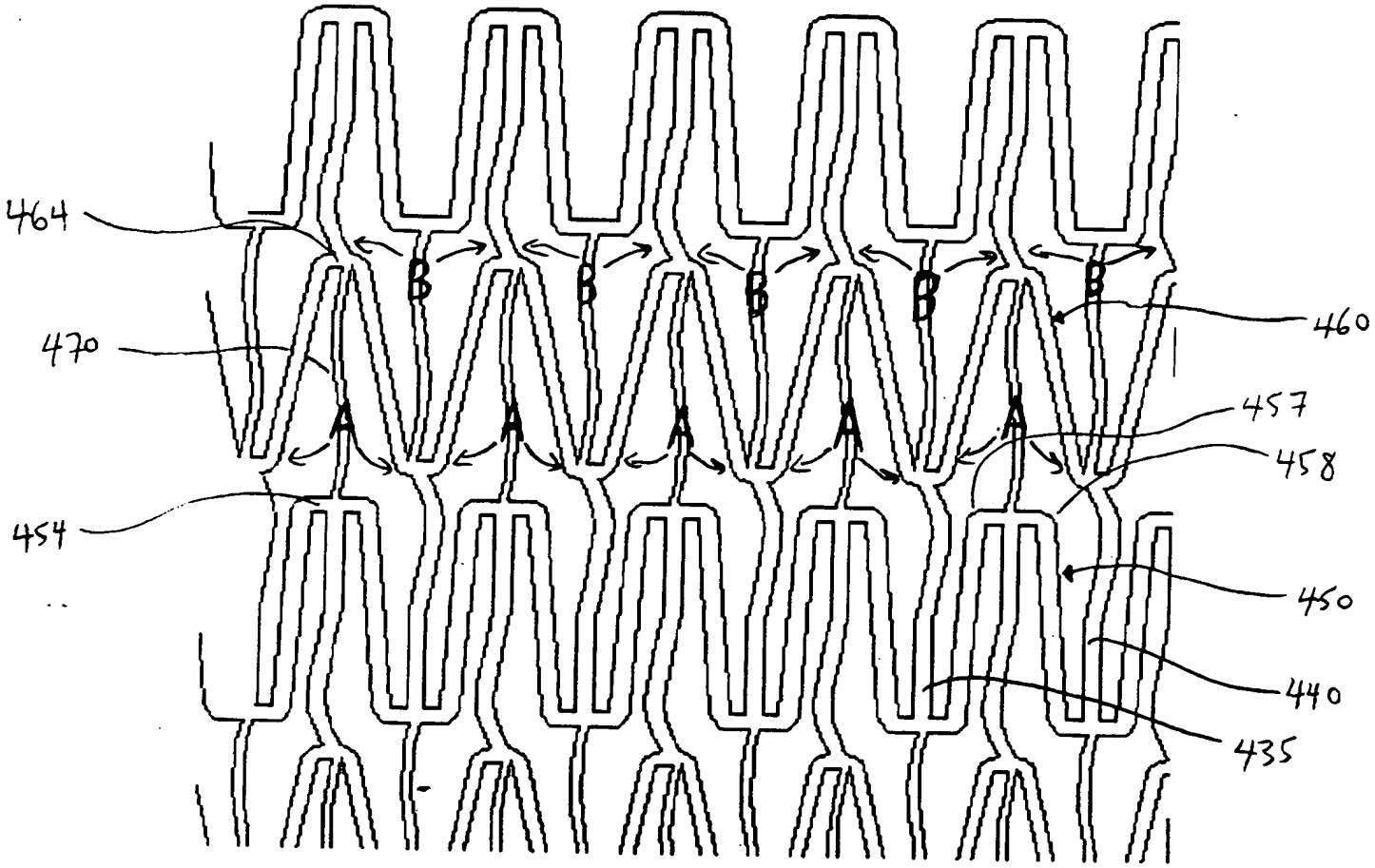

FIGURE 5

McCARTHY TÉTRAULT
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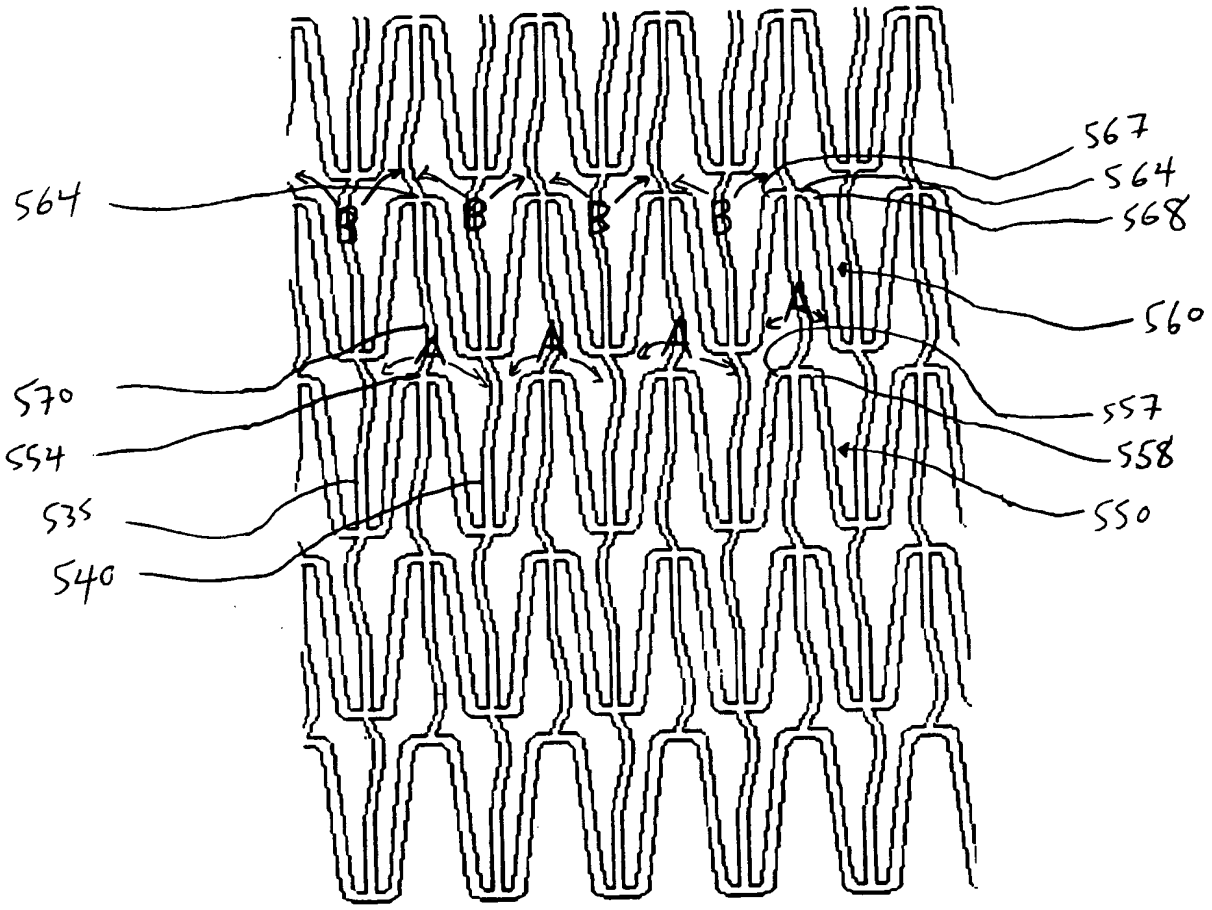

FIGURE 6

McCARTHY TÉTRAULT
AGENTS FOR THE APPLICANT